



(12) **EUROPEAN PATENT APPLICATION**

(88) Date of publication A3:
09.03.2022 Bulletin 2022/10

(51) International Patent Classification (IPC):
G06F 11/10^(2006.01) G06F 3/06^(2006.01)

(43) Date of publication A2:
02.03.2022 Bulletin 2022/09

(52) Cooperative Patent Classification (CPC):
**G06F 11/1076; G06F 3/0619; G06F 3/064;
G06F 11/1096**

(21) Application number: **21165647.5**

(22) Date of filing: **29.03.2021**

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

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(30) Priority: **13.07.2020 US 202016927798**

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(54) **METHODS FOR DISTRIBUTED IN-STORAGE COMPUTATION-CONSCIOUS ERASURE CODING**

(57) A method includes sending, from an application layer (102), a chunk size setting (120) to an erasure coding layer (104). The method further includes receiving, at the application layer (102), user data (108, 110, 112). The method further includes aligning, at the application layer (102), the user data (108, 110, 112) based on the chunk size setting (120). The method further includes sending the aligned user data (114, 116, 118) to the erasure coding layer (104). The method further includes partitioning, at the erasure coding layer (104), the aligned

user data (114, 116, 118) into a first data chunk (128, 144, 146) and a second data chunk (130, 140, 148). The method further includes generating, at the erasure coding layer (104), a parity chunk (136, 138) based on the first data chunk (128, 144, 146) and the second data chunk (130, 140, 148). The method further includes sending, from the erasure coding layer (104), the first data chunk (128, 144, 146), the second data chunk (130, 140, 148), and the parity chunk (136, 138) to a storage system (106).

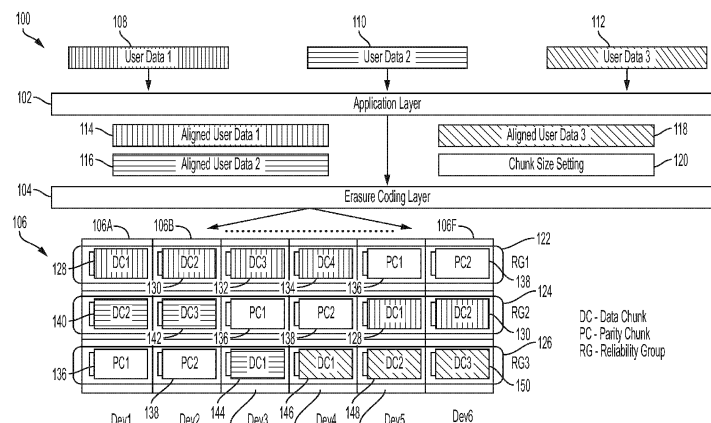


FIG. 1



PARTIAL EUROPEAN SEARCH REPORT

Application Number

under Rule 62a and/or 63 of the European Patent Convention.
This report shall be considered, for the purposes of
subsequent proceedings, as the European search report

EP 21 16 5647

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 2010/332751 A1 (QUIGLEY JOHN [US] ET AL) 30 December 2010 (2010-12-30) * abstract * * figures 1, 4, 17 * * paragraph [0048] - paragraph [0049] * * paragraph [0070] - paragraph [0072] * * paragraph [0085] - paragraph [0087] * * paragraph [0108] * * paragraph [0151] - paragraph [0159] * * paragraph [0237] *	1-6	INV. G06F11/10 G06F3/06
Y	SUN WEIDONG ET AL: "A Discrete Data Dividing Approach for Erasure-Code-Based Storage Applications", 2014 IEEE 8TH INTERNATIONAL SYMPOSIUM ON SERVICE ORIENTED SYSTEM ENGINEERING, IEEE, 7 April 2014 (2014-04-07), pages 308-313, XP032606636, DOI: 10.1109/SOSE.2014.44 [retrieved on 2014-06-11] * the whole document *	1-6	TECHNICAL FIELDS SEARCHED (IPC) G06F

INCOMPLETE SEARCH

The Search Division considers that the present application, or one or more of its claims, does/do not comply with the EPC so that only a partial search (R.62a, 63) has been carried out.

Claims searched completely :

Claims searched incompletely :

Claims not searched :

Reason for the limitation of the search:
see sheet C

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EPO FORM 1503 03.82 (P04E07)

Place of search Munich	Date of completion of the search 26 January 2022	Examiner Lanchès, Philippe
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document		



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EPO FORM 1503 03.82 (P04C10)

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (IPC)
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	
Y	US 2018/096049 A1 (KONDILES GEORGE [US] ET AL) 5 April 2018 (2018-04-05) * abstract * * paragraph [0056] * * paragraph [0092] - paragraph [0102] * * figures 7-9 *	1-6	
A	----- YUCHONG HU ET AL: "NCFS: On the Practicality and Extensibility of a Network-Coding-Based Distributed File System", NETWORK CODING (NETCOD), 2011 INTERNATIONAL SYMPOSIUM ON, IEEE, 25 July 2011 (2011-07-25), pages 1-6, XP031928297, DOI: 10.1109/ISNETCOD.2011.5978919 ISBN: 978-1-61284-138-0 * the whole document * -----	1-7	TECHNICAL FIELDS SEARCHED (IPC)



INCOMPLETE SEARCH SHEET C

Application Number

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Claim(s) completely searchable:

1-7

Claim(s) not searched:

8-19

Reason for the limitation of the search:

1 Applicant's indication according to Rule 62a(1) EPC

1.1 Applicant's arguments according to which present independent method claims 1, 8 and 14 would comply with Rule 43(2) are not convincing for the following reasons:

1.1.1 Applicant refers to paragraphs [0002] and [0007] and argues that the methods defined by independent claims 1, 8 and 14 would allow "more efficient in-storage computations". Such a broad effect is not convincing since said independent claims fail to define any in-storage computation.

1.1.2 To the extent that the efficiency of computations is supposed to relate to the erasure coding and further assuming (based on paragraph [0003] of the description) that erasure coding would be executed on storage devices (which is not defined by the claims), then only independent method claim 1 defines the necessary technical features to achieve such an effect. Note that in any case, this effect cannot apply to independent method claim 8, since this claim performs erasure coding in the application layer, which according to paragraphs [0026] and [0053] is "executing on one or more computing devices", the latter being distinct from the storage system.

1.1.3 The later observation is clearly emphasised by the fact that the next two paragraphs [0004]-[0005], of the description, which relate to independent method claims 8 and 14, respectively, mention a different effect, namely preventing "related data from being split across different storage devices". However, gain this effect is not achieved solely based on the claimed features, because the latter fail to specify different storage devices and any storage relationship between data and storage devices. Moreover, even the aligning feature, on which the mentioned effect relies, is absent from claims 8 and 14.

1.2 As a consequence, the search division maintain their opinion, according to which independent method claims 1, 8, 14 do not relate to alternative solutions of a particular problem.

1.3 Therefore, as indicated in the previous invitation according to Rule 62a(1) EPC, the search is limited to the subject-matter defined by independent method claim 1 and its dependent claims 2-6.

1.4 As a result, in subsequent examination proceedings before the EPO, the claims will have to be limited to the searched subject-matter. Any possible amendments may not relate to subject-matter not searched in accordance with Rule 62a.

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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26-01-2022

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EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82